dentally kept back by a breakdown and the storms, now just ready to sail for Copenhagen, and we send two messengers, hoping they will reach the steamer, and perhaps make it wait for us and take us home. We have but very little hope, though, that the steamer will wait, and we shall be compelled to stay here over winter, as this is the last chance this year."

It appears that the steamer did not wait for them, but took the letters and delivered them at Farsund, the nearest port in Norway. The expedition, consequently, must stay in Greenland through the winter, with the prospect of getting plenty of leisure time, and next summer we shall have a full report of this remarkably daring and interesting journey.

GEOLOGY AND PALÆONTOLOGY.

DESCRIPTION OF NEW AND IMPERFECTLY KNOWN SPECIES OF BRACHIOPODA, FROM THE DEVONIAN ROCKS OF IOWA.—Of the Brachiopod Fauna of the Devonian rocks of Iowa, no genus is, perhaps, so variable as the Genus *Atrypa*. Many varieties of *Atrypa recticularis*, of the Iowa strata, are often restricted in their range to certain horizons and localities. For example, at Iowa City, Turkey Creek and Roberts' Ferry, in Johnson county, there occurs in a bed of argillaceous shale a very large and coarse variety of this species, which is not known to appear at any other locality in Iowa, or elsewhere. In some dark bituminous shale at Independence, occurs another variety of the same species, and which is analogous to one of the varieties of the Rockford shales; this form, however, differs from the Rockford shale variety in its very diminutive size.

In the limestone at "Big Bend" of the Iowa river in Johnson county, at Independence, Waverly, etc., occurs another well-marked variety. Many individuals of this variety possess very large thin wings or expansions, the entire shell having a diameter of from five to eleven centimeters; the body of the shell, however, being often only one-half or even one-third that diameter.

At Littleton, in Buchanan county, is found another very distinct variety (a coarse form) whose equivalent is not known to occur at any other locality in the State; its nearest representative, so far as known to me, occurring in the Devonian strata at Louisville, Ky. In the Rockford shales occur two varieties, the smaller of which has the front of the shell so strongly contracted as to produce a dis-

tinct false mesial sinus in the ventral valve. Several other varieties of this species also occur in different portions of the State.

Not only do the Iowa varieties of this species vary greatly in form, size and surface markings, but they also often differ conspicuously in their internal structure. Some forms of this species approach so near to *Atrypa impressa* of the Schoharie Grit of New York, that a strict distinction between them is impossible. *Atrypa reticularis* of the Iowa strata varies so much in form, size, surface marking, etc., that it could be separated into several forms sufficiently distinct to have specific names, if the forms were found only distinct groups of rocks. *Atrypa hystrix* and *Atrypa aspera* also vary greatly in form, size and internal structure. An interesting feature of the Brachiopod and Polyp faunas of the Devonian strata of Iowa, is the occurrence of quite a number of forms which imperceptably grade into one another; but which forms are seen, in the rocks of other States, to constitute well-marked species. This condition is more particularly noticeable among some forms of the genera *Favosites*, *Cyathophyllum*, *Atrypa* and a few others.

Spirifera substrigosa, n. sp.—Shell a little larger than medium, somewhat longer than wide, slightly gibbous; cardinal extremities abruptly produced into short rounded projections. Dorsal valve moderately convex; greatest convexity slightly above the centre. Mesial fold angular, strongly produced in front; marked by five small scarcely elevated rounded plications, only one of which reaches the beak. Valve, on each side of the mesial fold, marked by five strong, broadly rounded radiating plications; cardinal extremities smooth. Ventral valve rather gibbous; greatest convexity about the centre; mesial sinus rounded, of moderate depth, quite rapidly expanding below, and produced into a moderately broad rounded extension; beak much elevated, sharp and strongly incurved; foramen rather large, triangular; area moderately large, concave.

Surface of the ventral valve, on each side of the mesial sinus, marked by six or seven strong, rounded, radiating plications; a small area on the cardinal extremities smooth. Mesial sinus ornamented by four small slightly elevated plications, the two outer ones becoming obsolete a little above the centre of the valve, and the two central ones uniting about the centre of the valve and extending to the beak as one. The front fourth of each valve marked by strong undulating lines of growth; the rest of the surface smooth. This species is more closely allied to *Spirifera strigosa* than to any other described species known to me. Position and locality: Rockford Shales, Hackberry, Iowa.

Spirifera hungerfordi Hall. (Compare with original description, Geology of Iowa, Vol. I, Part 2, p. 501.)—Shell very variable, adult forms often being three and one-fifth centimeters in width,

and about three and one-half centimeters in height; inequivalve hinge line sometimes (in both young and old specimens) extremely produced into wing-like expansions; at other times the hinge line equalling, or much less than the greatest width of the valves below; again, some specimens (old and young) are longer than wide; at other times wider than long, even though the hinge line is not produced.

Dorsal valve generally regularly convex, but sometimes flattened on the cardinal extremity; greatest convexity at or a little above the middle; beak incurved slightly beyond the hinge line; mesial fold often not defined; at other times slightly defined; and rarely strongly and sharply defined in front.

Ventral valve gibbous at or above the middle, having twice as great an elevation as the opposite valve; beak generally much extended above the hinge line, but sometimes scarcely; sharply incurved, or not incurved; sinus sometimes wanting, at other times shallow and scarcely defined above the middle, and producing a slight sinuosity (at times strongly produced) in front; in some specimens with greatly produced hinge lines, the sinus is quite well defined nearly or quite to the beak; area large and well defined, principally confined to the ventral valve, vertically striated; foramen narrow, triangular, extending quite to the open valve, the margins or dental lamellæ often a little projecting. Surface marked by fine rounded radii; radii about equal to the space between them, "and both are again finely striated in the same direction by microscopic lines, and the whole crossed by fine striæ which give a granulated appearance to the uneven surface"; this feature, however, is not always well shown even in well-preserved specimens.

The "dichotomising of the radii on the mesial sinus and fold" is by no means a constant feature. The internal structure of this shell varies considerably in different individuals. The dental lamella, which is usually very strong, generally extends to the centre of the valve, and there becomes obsolete; these lamellæ gradually diverge downward and about the centre of the valve, between them, is a deep heart-shaped muscular impression, marked by four to six more or less prominent vertical striæ; the dental lamellæ sometimes extend to the centre of the shell only as slight elevations along the margins of the muscular impressions; the muscular impressions vary somewhat in size, depth and general form in different specimens.

In some instances, the interior of the ventral valve is distinctly punctate; cardinal processes of dorsal valve rather large, bifid, and fitting into notches in area of ventral valve. Internal spires rather large. Position and locality: Throughout the Rockford Shales, Iowa.

Spirifera strigosa Meek. *Spirifera macra* Meek (1860), Pro-

ceed. Acad. Nat. Sci., Phila., XII, 309. *Spirifera strigosa* Meek (1860), to extra copies of the above cited paper. *Spirifera orestes* Hall and Whitfield (1873), 23d Rept. Board of Regents on N. Y. State cabinet, P. 237, *Spirifera strigosa* Meek (1876), in Col. Simpson's Report Expl. across the Great Basin of Utah, 347, pl. I, figs. 5,a,b,c,d. Compare with description of *Spirifera orestes*, of H. and W., 23d Report of Board of Regents on New York State cabinet of Nat. His., p.237; and also with description of *Spirifera strigosua* Meek, U. S. Geol. Exploration of Fortieth Parallel, Vol. IV., p. 43.

Shell very variable; semielliptical, subouate, suborbicular, longer than wide or wider again than long; of medium or under medium size; often gibbous in young as well as old specimens; frequently greatly extended on the hinge line, sometimes hinge-line one-third less than the greatest width of the valves below; at other times the hinge-line and valves below are equal, valves subequal; greatest convexity of the ventral valve at or slightly above the middle; greatest convexity of the dorsal valve at the centre, or a little above. Beak of ventral valve strong and usually high, sometimes low; from slightly to very sharply incurved; the height, strength and curvature of the beak varies somewhat with the age of the animal; central area high, concave, vertically striated; foramen rather large, triangular, extending to the apex of the valve, the margins or dental lamellae strongly projecting in well-preserved specimens.

Valves marked by very large or small, simple, rounded or angular plications; varying in number from four to thirteen on each side of the mesial fold and sinus, in young as well as adult forms.

Mesial fold and sinus marked by from one to six bifurcating plications (in some instances, the plications do not bifurcate, but run out along the margins of the fold and sinus). Usually the mesial fold is strongly elevated in front and more or less well defined to the beak, but in rare instances, even in adult specimens, the fold is not defined, even in front, although the sinus of the opposite valve is well defined to the beak, and produced in front.

Mesial sinus more or less well defined to the beak, rather rapidly expanding below, and produced in front into a sharp or broadly rounded extension; bottom shallow or deep, angular or rounded. Surface of specimens, with small or medium-sized plications, marked by very fine striæ parallel to the plications; surface of specimens with large, coarse plications, marked by stronger and more numerous oblique striæ, which unite with each other on the summit of the plications and centre of the depressions between the plications, thus giving the entire surface a very sharply zigzag striation; the surface of many specimens are also crossed, in front, by slight lines of growth.

Surface of the interior of the valves smooth or marked by ridges, which correspond to the depressions between the plications on the

exterior of the valves; dental lamellæ in ventral valve slightly produced, sloping abruptly backward and downward, becoming obsolete before reaching the center of the valve; cardinal processes of dorsal valve small, bifid, fitting into notches in area of ventral valve.

This is one of the most variable species of Spirifers known to me. The descriptions of this species, and *Spirifera hungerfordi*, are based upon over one hundred and fifty specimens of each species.—Position and locality: Rockford Shales, Rockford and Hackberry, and Owens Grove, Iowa.

There seems to be no doubt but that this very variable species (designated as *Spirifera orestes*, by H. & W.,) is identical with *Spirifera strigosa* Meek as described in Vol. IV., p. 43, of the U. S. Geol. Exploration of Fortieth Parallel. This being the case, Meek's name would, therefore, be considered as having the priority.

Atrypa hystrix var. *elongata*, n. var.—Shell of medium size, elongate ovate, valves slightly and nearly equally convex; greatest convexity of the ventral valve slightly below the umbo; greatest convexity of the dorsal valve on the umob. Beak of the ventral valve of moderate strength, perforate, scarcely raised above the opposite valve; area closed, surfaces marked by from four to five simple rounded ridges upon each valve, crossed by strong thickened concentric laminæ of growth, but which are not elevated at intervals into spine-like protections. This well-marked variety is known to occur at only one locality, the Rockford Shales, at Hackberry, Iowa.

Atrypa hystrix var. *planosulcata*, n. var.—This form differs from *A. hystrix* in the general expression and fineness of the shell. The plications are very much smaller and more numerous, the laminæ of growth usually slight and not generally elevated into spine-like projections. These features are very constant in both young and old specimens.

We were at first inclined to consider this form specifically distinct from *A hystrix*, but after a large number of them had been secured, it proved that they constituted only a well-marked variety of this species.

This variety is common throughout the Rockford Shales, and is also the prevailing form which occurs in the limestone which immediately underlies the shales. We have also secured a very few specimens from some shales at Roberts' Ferry, Solon and Turkey Creek, in Johnson county.—*Clement L. Webster.*

CAVES AND CAVE LIFE.—There are a few statements made in Dr. Packard's article in the September number of the AMERICAN NATURALIST, which, while they do not affect the argument, seem to need

correction. First, on pp. 814–815, occurs the statement: "It is probable that *Cæcidotea stygia* is seldom, if ever, brought in contact with *Asellus communis*, which abounds in the pools and streams throughout the cave region." For this I can see no reason. As I have lived for some time in the cave region, I may say that Cæcidotæa is not confined to "caves and wells fed by underground streams," but occurs in Bloomington in springs and in the ordinary streams, mingling with its near relative Asellus. Again, except for the single element of darkness, I cannot see how the cave fauna, occurring in the numerous caves around this town, and extending south to Wyandotte and Mammoth, "is almost completely isolated from that of the upper world." Too many of the streams in this carboniferous belt drop out of sight, and can be traced directly into caves about here to afford much isolation to aquatic animals.

Not having seen the complete article from which his paper "On Certain Factors of Evolution" is an extract, I do not know on what Dr. Packard bases his conclusion (p. 815) that the cave faunæ are to be regarded as products of Quaternary times. Of course the general facies of that fauna is recent, but it is, on the other hand, beyond question that the caves themselves have been in process of formation since their rocks were elevated above the carboniferous sea. I know of no argument which forbids the idea of their being peopled in Permian times. The fact that we have no cave fossils giving evidence of a Mesozoic fauna is easily explained by the fact that there was no locality for such fossils to form. Caves are constantly being enlarged by a solution of their walls, and with the wearing away of the rock all cave-animal remains would of necessity be destroyed.

While on this subject of caves I may call attention to a few facts which I have observed during the past year in regard to their formation, and I do so the more willingly since I find a belief quite prevalent that they were caused by the "Champlain floods." Southwestern Indiana and Central Kentucky and Tennessee are, *par excellence*, the cave region of America. A few caves have acquired more than local prominence, yet from Bloomington south, one cannot go a dozen miles without striking several caves. Now all this region is below the line of the drift; nowhere in it can one find a single morainic boulder. It is rather a region of topographic old age. The "Knobs" which skirt the Ohio, from Louisville to Evansville, are produced solely by atmospheric agencies, and the same physical features characterize the whole region. In the valleys, to be sure, occur the channels which must have borne off the floods caused by the melting ice of the Continental glaciers, but the river-courses of to-day but occasionally coincide with those which must be invoked to explain the presence of the caves. To explain the existence of the caverns we must predicate streams whose

beds have now entirely disappeared, except as they are shown inside the caves. For instance, the Blue river of to-day cannot be connected with Wyandotte Cave. The entrance to the cave occurs on a side hill, a hundred feet above the present stream, yet inside the cave there is ample evidence, not only of the long-continued action of small amounts of water, but, in places, the plainest signs of a considerable stream. So, too, in Little Wyandotte, a few rods away. Still, where that water entered the cave, and where it made its exit, are as yet unsolved problems. In the majority of caves which I have seen, the entrance seems a secondary formation produced by a falling in of the roof, or a wearing away of the hill itself. This last is clearly the case with Wyandotte Cave, which apparently once had a greater extent than it now has. In other cases the entrance is through a "sink-hole," but it requires no little credulity to believe that that little funnel conducted the water which wore away such a cavern as "Coon's Cave" in this county (Monroe).

Some facts which I have observed, but which I have not seen recorded, seem to show that this cave region formerly contained more caves than now, but that they have disappeared by wearing away of the rock in which they were contained. On the slope of the hill, near the path which leads from the Wyandotte Cave Hotel down to the well at the fort, where the blind fish are found, are apparently the remains of a cave, the walls and roof of which have utterly disappeared, the only traces which remain being the stalagmites on the floor. So, too, on Blue river, about half way from Wyandotte to the Ohio, occur what are known as Castle Rocks, and these turrets, rising several feet above the surrounding country, seem to be the last vestiges of a former cave of considerable dimensions, the other walls of which have been carried away.

These facts, which I have thus jotted down, all go to show that in the Indiana-Kentucky-Tennessee cave region, time has been no inconsiderable element in the process of cavern formation, and I believe that the majority of the caves about here had acquired essentially their present sizes and dimensions long before the appearance of the "great glacier" so often invoked to explain all sorts of phenomena in dynamical geology. That it is not at all adequate to account for the caves is evident to any one who visits this region. Recourse must be had to a time when the whole physical geography was different, and when southwestern Indiana was not cut up into its present condition of steep hills and cañon-like water courses.—*J. S. Kingsley, Bloomington, Ind.*

GONIOPHOLIS IN THE JURASSIC OF COLORADO.—In my essay on the horizons of vertebrate fossils of Europe and North America,

read before the International Congress of Geologists of 1878,[1] I recorded the probable occurrence of this Jurassic genus of Crocodilia in North America. This supposition has become a certainty, as a result of a more detailed examination of material received from Mr. O. W. Lucas, of Canyon City, Colorado. This consists of a nearly entire skull, with numerous portions of the skeleton, derived from the locality which furnished the typical specimens of *Camarasaurus supremus* Cope, and other Reptilia. It appears that the specimen is specifically identical with one which includes vertebræ and a few other bones only, described by me as *Amphicotytus lucasii*,[2] from the same locality. The species may be therefore called *Goniopholis lucasii.*

The superior surfaces of the skull and dormal scuta are rather finely and profoundly pitted. The orbits are a little smaller than the crotaphite foramina, and each one has a strong supraorbital bone, which is also pitted. The muzzle is of moderate length, and is proportioned much as in the Nile crocodile. Its extremity is neither abruptly expanded nor recurved. The anterior teeth are sculptured with coarse, shallow, parallel grooves. Those of the posterior portion of the maxillary bone have opposite angles at the extremities of a transverse axis extending inwards and forwards and outwards and backwards, but the crown is not compressed at the base, though slightly so at the apex. The posterior nares are narrow, and are divided by a median septum. Their anterior border is opposite the middle of the palatomaxillary foramen. The pterygoids terminate posteriorly in a wide, free, transverse margin.

The *Goniopholis lucasii* was equal to a two-thirds grown Mississippi Alligator in dimensions, and its head was of relatively larger size. It was smaller than the *G. crassidensowrn.*

Measurements.

Length of cranium on median line	.385
Length from end of muzzle to line of orbits	.245
Length from end of mnzzle to line of crotaphite foramina	.310
Width of cranium between quadrates inclusive	.250
" " table of cranium	.110
" " parietal space	.015
" " interorbital space	.040
" " muzzle at front of orbits	.110
" " muzzle at nares	.090
Length of fore part of pseudocanine tooth	.035
Width of fore part at base of crown	.013

E. D. Cope.

AMERICAN FOSSIL CRYPTOGAMIA.—At a meeting of the Biological Society of Washington on Nov. 17th, Prof. L. F. Ward read a paper,

[1] Comptes Rendus Stenographiques, Paris, p. 146; Vertebrata Tertiary of the United States, 1885, p. 26.

[2] Bulletin U. S. Geolog. Survey Trans. F. V. Hayden, 1878, p. 391.

on "A comprehensive type of fossil cryptogamic life from the Fort Union group," illustrating it by lantern views. The fossil in question was so peculiar that though collected in 1883, he had done little with it until the present season. Photographs of it were sent to various eminent zoologists and botanists, with a view of determining the affinities of the curious specimen. Zoologists could not refer it to any animal, and so considered it a plant; while botanists, knowing no plant like it, thought it possibly an animal. Prof. Ward's conclusion so far is that it represents a generalized type of vascular cryptogam, with relationships to Ophioglossum, Isoetes, Marsilea, Lycopodium and Selaginella. It is evidently an aquatic, fresh water, as shown by the remains of aquatics in the same connection. A central, roundish rhizoma or rhizoid, is surrounded by slender, flexuous bodies, radiating in all directions, each expanding from a rather narrow base to a broad club-like end. The scales are arranged in two or three rows; at the base are found numerous round bodies like spore cases, and the free end has a flattened blade about twice as wide as the main stem and rounded. In the general aspect of the rhizoma it is related to Isoetes. In its branches and fructification to Ophioglossum and Marsilea, and in its scales to Lycopodium and Selaginella. Letters from Prof. Farlow, Dr. Nathorst and Count Saporta, were read, and these scientists suggested a possible connection with the same forms of cryptogams as Prof. Ward had himself imagined. In a discussion which ensued, Prof. Seaman called attention to the similarity the specimens presented to the structure of the hairs of *Drosera rotundifolia*. It would indeed be strange if in this fossil plant of Cretaceous times we should have foreshadowed and produced on a large scale the hairs of Drosera, each acting independently instead of working in common. It must be said, however, that the chances are greatly in favor of the view of Prof. Ward, that it is a generalized form of certain groups of the vascular cryptogams.—*Jos. F. James.*

A Horned Dinosaurian Reptile.—In the December number of the *American Journal of Science and Arts*, Prof. O. C. Marsh describes parts of the skeleton of a Dinosaur from the Laramie formation of Montana, including parts of the skull. The latter is remarkable in supporting on its posterior part a robust horn-core on each side, somewhat like that of the ruminating mammals. Prof. Marsh concludes that the genus to which this animal belongs is allied to Hypsirhophus (Stegossaurus) of the Jurassic. This interesting discovery of Prof. Marsh will solve a problem which has remained unsettled for over ten years. In 1877, in the *Bulletin of the U. S. Geological Survey* of the Territories, Vol. III., p. 588, the present writer described parts of the skull of this animal and figured some

of them, including a horn-core and posterior part of the skull (Plate XXXII., fig. 8). These fragments were also found in the Laramie bed of Montana, probably at no great distance from those described by Prof. Marsh. I did not determine the genus to which this cranium should be referred, since there were already known nine genera of Dinosauria from the same horizon to one or the other of which, it was sure to belong. The observations of Prof. Marsh will determine this point. The affinity to Hypsirhophus referred to by Prof. Marsh indicates Polyonax (Cope) as the form to which the species probably belongs, although this is of course a mere surmise. That genus was described from vertebræ and limb and dermal bones (Cretaceous Vertebrata U. S. Geol. Survey Terri., II., p. 63, Plates II. and III.). Some of the latter were probably identified with doubt as parts of the shafts of limb bones, but they resemble more nearly some of the spinous dermal bones ascribed to Hypsirhophus by Marsh.

It would have been well if the final publications of the Hayden Survey could have been completed by the Director who succeeded him in charge, instead of new publications taken up. In that case the continued duplication of the work of the first survey by its successor could have been avoided.—*E. D. Cope.*

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—Löwinson-Lessing[2] has suggested a scheme for the classification of elastic rocks. He would divide these into tuffs, breccias, conglomerates, pseudoschists and slaty rocks. Tuffs he would confine to rocks made up of crystals, or pieces of crystals, and separate minerals, and would subdivide into agglomerates-tuffs (subaëreal) and tuffogenous sediments (submarine). The agglomeratic tuffs he would further separate according to structure. Tuff-like rocks produced from crystalline rocks by orodynamic forces, or by weathering, he would call tuffoids, and distinguish as elasto-tuffs and decomposition-tuffs (Verwitterungs tuffen). The breccias are composed of pieces of rocks cemented by rock material. They are divided into primary, or volcanic, and secondary, or metasomatic breccias. The volcanic breccias include the lava agglomerates (Reibung's breccias), composed of pieces of foreign rock, or of the crust of a lava stream, which have been cemented together by a molten rock, and tuff-lavas (Spaltung's breccia),

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Miner. u. Petrog. Mitth., ix., p. 528.